

# PATENT SPECIFICATION

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## COMPLETE SPECIFICATION

### A Centring Device for Centring Conduits and the like in Well Bores

We, BAKER OIL TOOLS, INC., a corporation duly organized under the laws of the State of California, of 6000 South Boyle Avenue, Los Angeles, State of California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to devices for centring casings, liners and similar well conduits in well bores.

16 An object of the present invention is generally to improve centring devices of the character above indicated.

Another object of the invention is to provide a casing centraliser embodying 20 outwardly bowed springs, in which the springs are subjected to a minimum bending moment and minimum deformation under extreme loading conditions.

A further object of the invention is to 25 provide a casing centraliser that can be mounted easily on a casing string to which a stop member is secured for pulling the centraliser through the well bore.

30 Still a further object of the invention is to provide a casing centraliser that can be easily mounted on the casing string on opposite sides of a casing coupling collar, in order that the collar can function as a stop member for pulling the centraliser 35 through the well bore.

Another object of the invention is to provide an improved hinge type casing centraliser, in which the hinged portions can be secured together, after the centraliser has been mounted on the casing string, in a rapid and facile manner.

40 According to the present invention there is provided a centring device for centring well conduits and the like in well bores, in which bowed leaf springs are

secured to and between a pair of longitudinally spaced members slidably mounted on a conduit, said members including an upper and lower cage assembly, each of which assemblies has 50 an inner stop collar disposed adjacent the medial portions of said leaf springs and an outer collar, the collars being interconnected by a plurality of rigid circularly spaced bars, the distance 55 between said stop collars being slightly greater than the length of a stop means which is positioned therebetween.

One particular embodiment of the present invention is shown in the drawings 60 accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that 65 such detailed description is not to be taken in a limiting sense, since the scope of the invention is defined by the appended claims.

Referring to the drawings:

70 Figure 1 is a side elevation, with parts broken away, of a casing centraliser mounted on a string of casing, prior to running of the casing in the well bore;

75 Fig. 2 is a longitudinal elevational and sectional view, similar to Fig. 1, disclosing the casing string and centraliser in a well bore;

Fig. 3 is a cross-section taken along the line 3—3 on Fig. 1;

80 Fig. 4 is an enlarged fragmentary side elevation of one of the hinges forming part of the centraliser;

Fig. 5 is a longitudinal section taken along the line 5—5 on Fig. 4.

85 A casing centraliser A is illustrated in the drawings as mounted upon a casing string, which includes an upper casing section B, a lower casing section C, and an intervening coupling collar D 90

threadedly secured to the opposed pin ends 10, 10 of the casing sections; in order to hold them rigidly together. In the specific form of the invention illustrated, the coupling collar D functions as a stop member, that pulls the casing centraliser A through the well bore, regardless of the longitudinal direction of movement of the casing string therein.

The casing centraliser includes an upper cage assembly 11, that can be mounted on the upper casing section B above the coupling collar D, and a lower cage assembly 12, that can be mounted on the lower casing section C below the coupling collar D. These cage assemblies 11, 12 are secured to one another by intervening outwardly bowed leaf springs 13, which extend completely across the coupling collar or stop member D.

Each cage assembly 11 or 12 includes an outer spring annulus or collar 14 and an inner stop annulus or collar 15, these two collars being connected together by rigid interconnecting members or bars 16, whose inner and outer ends abut and are welded to the inside surfaces of the collars. The interconnecting bars 16 preferably do not extend laterally beyond the inner or outer surfaces of the collars 14, 15. Sufficient bars are provided, circumferentially spaced from one another, to form comparatively rigid cage assemblies 11 and 12.

The outwardly bowed springs 13 are preferably uniformly spaced around the cage members 11, 12 and have their end portions 13a secured to the spring collars 14. As an example, the ends 13a may be disposed in inner notches 17 in the collars 14, and they may be welded to the spring collars, as by the aid of welding material 18 extending across their outer ends.

For the purpose of enabling the casing centraliser A to be mounted upon an assembled casing string, which already possesses a stop member, such as the coupling collar D, each cage member is made sectional, with its spring collar 14 and stop collar 15 composed of two main semi-circular pieces. These pieces can be secured together by hinges 19, 20 to form a circumferentially continuous spring collar and stop collar. As disclosed in the drawings, at one side of the cage the two parts of the spring collar 14 are secured to one another by a hinge 19. The leaves 21 of the hinge are spot welded, or otherwise suitably secured to the outer surface of the collar sections, whereas the knuckle or barrel portions 22 of the hinge are interleaved with respect to one another, and are disposed between the adjacent ends of the collar sections. A suitable hinge pin 23 extends through the

knuckles 22, to pivotally secure the collar sections to one another.

A similar hinge arrangement is provided on the same side of the cage for the stop collar 15. The hinge arrangements are provided on both the upper and lower cages, the hinges 19 all being in alignment with one another, so as to enable the centraliser to be swung between open and closed positions about the hinge axis of the pins 23 in mounting the centraliser on the casing string, with the upper and lower cages 11, 12 on opposite sides of the coupling collar D.

The other side of the cages 11, 12 are similarly provided with hinges 20 in alignment with one another, the hinge leaves 21 being spot welded, or otherwise suitably secured to the exteriors of the collars 14, 15 and the knuckles or barrels 22 being disposed between the adjacent ends of the collar sections.

The hinge pins 23 of the hinges 19 at one side of the casing centraliser are in place and form the pivotal axis for swinging the casing centraliser between open and closed positions. The other hinge members 20 originally do not have a hinge pin extending through their interleaved barrel portions 22. After the centraliser has been swung to open position about the hinge axis on one side containing the hinge pins 23, and has been placed around the casing string, it can be swung to closed position with the barrels 22 of the hinges 20 interleaved with respect to one another. A pin 25 may then be inserted within the knuckles 22 of each hinge 20, for the purpose of holding the collars 14, 15 of the cages 11, 12 snugly around the casing sections B, C in slidable relation with respect thereto.

A rapid assembly can be made by constituting each of the last-mentioned hinge pins 25 as a drive screw or nail, whose shank 26 has steeply pitched, helically arranged ribs 27 that are adapted to cut grooves in the inner surfaces of the barrel portions 21 of the hinge 20. Each drive screw has a head 28 at one end of the shank and a tapered point 29 at the other end of the shank. The point of the drive screw is inserted in the outer knuckle 22 of a hinge 20, and the head 28 struck by a hammer. The tapered point 29 automatically aligns all of the knuckle members 22 with respect to each other, and the helical ridges or threads 27 cause the screw to turn slightly as the companion groove is formed in the knuckles 22. A tight fit is ensured when the drive screw 25 is driven into the hinge members 21, the pin 25 remaining firmly in place during use of the centring device in the well bore.

The drive pins 25 for the spring collars 14 may be inserted through the knuckles 22 in either an upward or a downward position. However, since the length of the coupling collar D is preferably only slightly less than the distance between the stop collars 15, the drive screw or pin 25 for the lower stop collar 15 must be inserted through the knuckles 22 of the lower stop collar hinge 20 in an inverted position, inasmuch as sufficient clearance may not remain between the coupling collar D and the lower stop collar 15 to allow insertion of the drive screw through the upper end of this hinge. Regardless of the direction in which any of the drive screws are inserted through the hinge, they cut their own threads on the hinge knuckle members 22, and hold the assembly permanently in place on the casing string.

Each cage assembly 11, 12 is relatively long. As disclosed in the drawings, a cage assembly may be approximately one-third of the over-all length of the casing centraliser. Such elongate cage assemblies are preferred, so as to dispose the stop collar members 15 closer to the central portions 13b of the leaf springs 13. They also result in the disposition of the stop or coupling collar member D opposite the central portions 13b of the leaf springs. This arrangement is preferred, since it provides a minimum interference with the inward collapsing of the springs to the maximum extent, and places a minimum of deformation on the springs 13 under extreme loading conditions, as when the springs are pressed inwardly to their fullest extent against the casing string.

After the casing centraliser A has been mounted on the casing string, the combination is lowered through the well bore. During this lowering movement, the coupling collar D engages the lower stop collar 15, the downward movement or force being transmitted through the rigid bars or columns 16 to the lower spring collar 14. Since the lower ends 13a of the springs are firmly secured to the lower spring collar 14 the springs 13 will be pulled through the well bore, and through any restrictions that might be encountered therein. When a restriction or tight place is encountered, the springs are urged inwardly toward the casing string, which shifts the upper cage 11 relatively in an upward direction away from the coupling collar D.

In a similar manner, upward movement of the casing string will cause the coupling member D to engage the upper stop collar 15 in order to exert a pulling action on the outwardly bowed spring members 13, which facilitates their pass-

age through a well bore and through any restrictions therein that might be encountered.

By making the cages 11, 12 relatively long, the stop collars 15 are brought closer to the central portions 13b of the outwardly bowed spring members. As a result, the springs must be deflected inwardly, under high loading conditions, to a substantial extent before a portion of each spring (as a part 13c) will engage the stop collar 15. When such engagement occurs a bending moment is placed on each spring member 13, tending to deform it. However, such bending moment is relatively small in the casing centraliser illustrated, since the placing of the stop collar 15 close to the central portion 13b of the spring reduces the moment arm of the inward force urging the spring toward the casing. In addition, the amount of the force tending to bend the spring 13 about the stop collar 15 is less, inasmuch as the spring is almost in its fully collapsed position before it engages the stop collar member 15.

It is also to be noted that the spring does not engage the stop member or coupling collar D itself, until the spring has been almost completely flattened against the casing string. As a result, there is very little opportunity for binding the spring upon the stop collar, which binding might tend to prevent rotation of the casing string within the centraliser A whenever such rotation is desired. If the springs were to bind upon the stop collar, rotation of the casing string might tend to rotate the leaf springs 13 with it, with potential damage to the centraliser device.

From the foregoing description, it is apparent that a casing centraliser has been provided that can be mounted on assembled casing sections B, C and which can utilize the casing coupling collar D as a stop member for pulling the centraliser through the well bore, regardless of the direction of longitudinal movement of the casing string. Of course, other stop collars or rings than the coupling collar D can be used, if desired, the centraliser being easily mounted on the casing section merely by first opening it about the axis of the hinges 19, and then moving it to closed position, with the cages 11, 12 opposite sides of the stop member, whereupon the centraliser can be unitized by forcing the drive screws 25 through the knuckles 22 of the hinges 20 on the side of the centraliser opposite the permanently hinged side. The springs can be loaded to an extreme condition before they will engage the stop members or collars D, and, even when so engaged, the bending moment is comparatively small, 130

so as to avoid permanent deformation of the springs 13, and the tendency for their breaking as a result of being bent around other members, such as the stop rings 15. In addition to the foregoing, the stop member D, which can be made of one or a plurality of parts, is held to a position substantially midway along the centraliser and is only engaged by the springs 13 when they are under extreme loading conditions. Such mid-positioning of the stop member D is assured by making the spacing between the stop collars 15 of the cages 11, 12 only slightly greater than the length of the stop member D itself.

What we claim is:—

1. A centring device for centring well conduits and the like in well bores, in which bowed leaf springs are secured and between a pair of longitudinally spaced members slidably mounted on a conduit, said members including an upper and lower cage assembly each of which assemblies has an inner stop collar disposed adjacent the medial portions of said leaf spring, and an outer collar, the collars being interconnected by a plurality of rigid circularly spaced bars, the distance between said stop collars being slightly greater than the length of a stop means which is positioned therebetween.

2. A centring device as set forth in claim 1 in which each of said cage assemblies is mounted on a different section of said conduit which are coupled together by a coupling therebetween which forms the stop means.

3. A centring device as set forth in claim 1 in which the collars of said cage assemblies are sectional and having co-axial hinges securing the respective sections of the collars of each cage assembly together at one side thereof, with means being provided at the opposite sides of said cage assemblies for securing the respective collar sections to each other.

4. A centring device as set forth in claim 3 in which said securing means comprises a hinge whose elements are attached to the respective section of each stop collar and outer collar with a drive screw forced through adjacent hinge elements at each collar.

5. A centring device for centring conduits and the like in well bores, substantially as described and shown in the accompanying drawings and for the purpose set forth.

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FIG. 1.

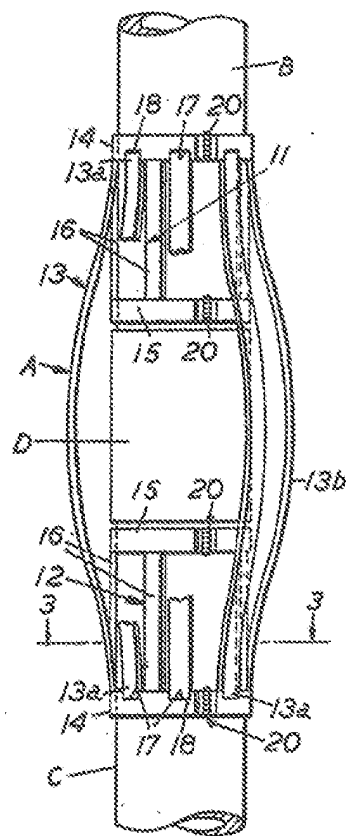


FIG. 2.

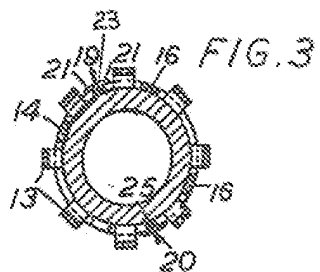
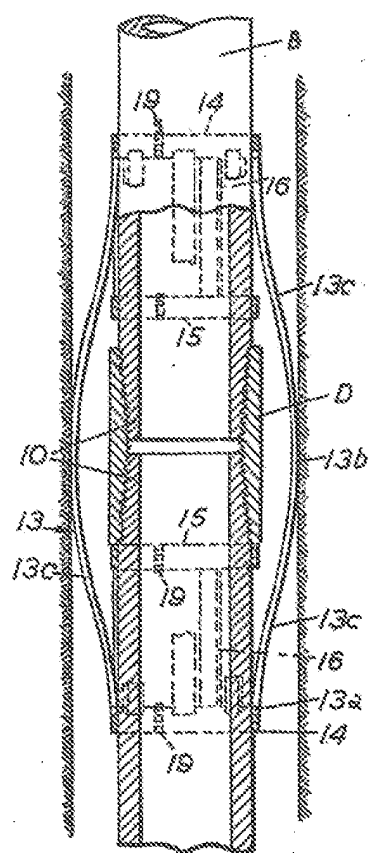


FIG. 4.

